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STATEWIDE EMISSION INVENTORY of SOUTH DAKOTA

by
Raymond D. Fox
Steven H. Chomsky

Prepared by
GCA CORPORATION
GCA TECHNOLOGY DIVISION
Bedford, Massachusetts 01730

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ENVIRONMENTAL PROTECTION AGENCY

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Annual emission levels are estimated for the following five pollutants: particulates; sulfur dioxide; carbon monoxide; hydrocarbons; and nitrogen oxides. The annual emission levels for each of these pollutants are established for each of the 67 counties in South Dakota as well as for the two principal cities, Sioux Falls and Rapid City. In addition, totals for these pollutants are presented for the four Federal Air Quality Control Regions in South Dakota. For each geographic area discussed above (region, county, city) the emission levels for each of the 5 pollutants are presented by source category. These categories are: stationary fuel combustion sources; transportation sources; solid waste disposal; and process losses. The data are accurate enough to be used in conjunction with ambient air quality measurements in the preparation of an implementation plan for meeting national ambient air standards.

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Carbon monoxide
Hydrocarbons
Nitrogen oxides
Combustion
Transportation
Refuse disposal
Processing
Rocks
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Concretes
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I. INTRODUCTION

A. BACKGROUND OF PROGRAM

A primary purpose of the Federal Air Quality Act of 1967 was to provide for planning and control programs on a regional basis. More recently, the Environmental Protection Agency has required the preparation, adoption and submittal of implementation plans for meeting national ambient air standards by each of the states.

An important first step in implementation planning is the carrying out of an emissions inventory to determine the principal pollution sources in the state. This report presents the results of an emissions inventory for the state of South Dakota.

B. DESCRIPTION OF PROGRAM

The study program is concerned directly with establishing annual emission levels for the following five pollutants:

Particulates,
Sulfur Dioxide,
Carbon Monoxide,
Hydrocarbons,
and
Nitrogen Oxides

The annual emission levels for each of these pollutants are established for each of the 67 counties in South Dakota as well as for the two principal cities, Sioux Falls and Rapid City. In addition, totals for these pollutants are presented for the four Federal Air Quality Control Regions in South Dakota. Table 1 presents a listing of these regions together with the respective counties comprising them. Figure 1 presents a map of South Dakota, showing their geographic locations.

For each geographic area discussed above (region, county, city) the emission levels for each of the 5 pollutants are presented by source category. These categories are:

- Stationary Fuel Combustion Sources - These include power plants as well as industrial, institutional, commercial, and residential facilities.

TABLE 1

FEDERAL AIR QUALITY CONTROL REGIONS

Region No.	Counties Comprising Region
086	Union
087	Lincoln McCook Minnehaha Turner
205	Butte Custer Fall River Lawrence Meade Pennington
206	Remaining 56 Counties

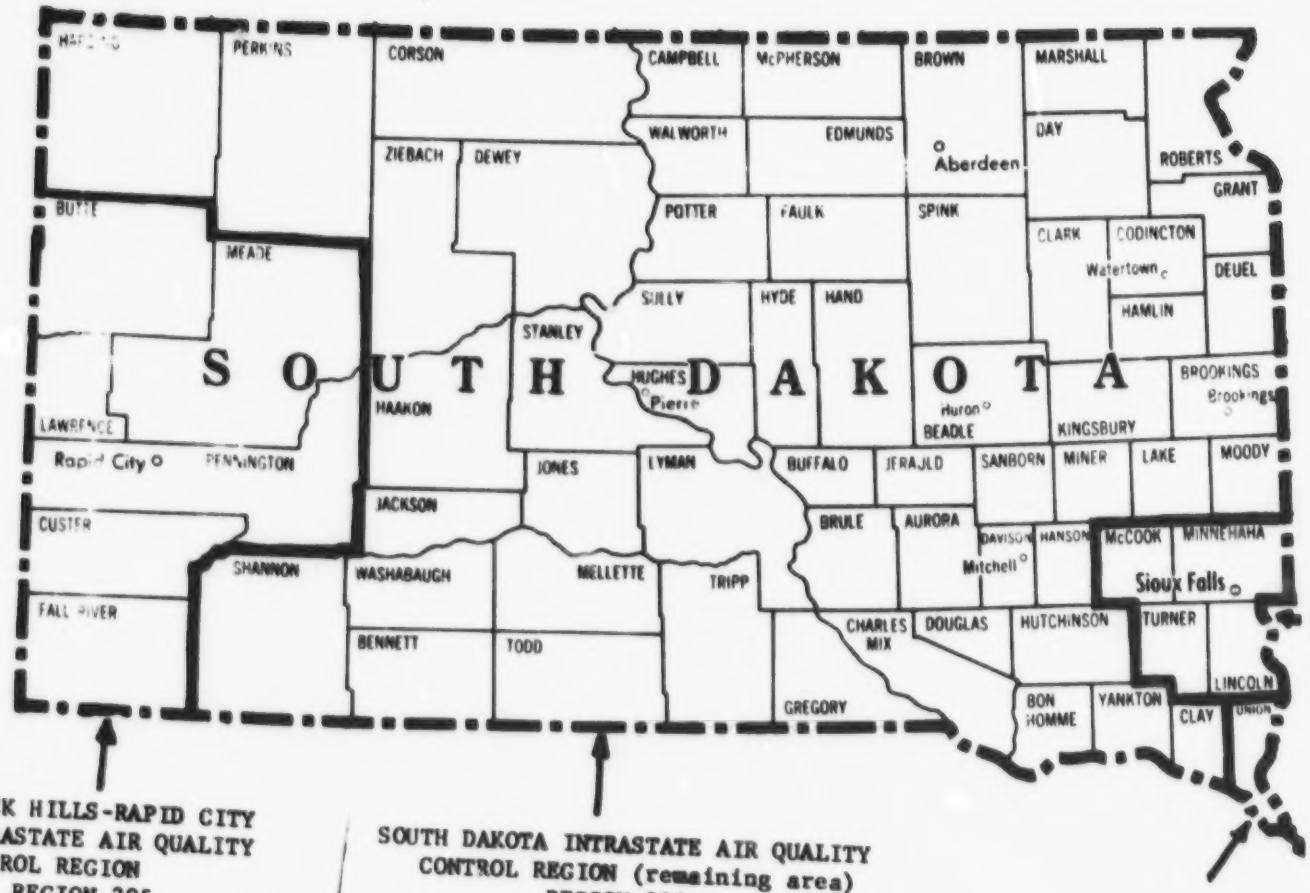

Figure 1 . Boundaries of Air Quality Control Regions.

- Transportation Sources - These include both gasoline and diesel-powered motor vehicles, aircraft and railroads. In addition, tractors, the major off-highway consumer of both distillate fuel oil and gasoline are classified in this source category. Also included are evaporative losses from gasoline marketing.
- Solid Waste Disposal - Municipal and private dumps which practice open burning, together with residential, commercial, institutional and industrial incineration and open burning comprise this source category. There are no municipal incinerators in South Dakota.
- Process Losses - These include stone crushing and processing, various minerals industries, asphalt and concrete batch plants, meat packing and over 400 grain elevators spread throughout the state. Also included are evaporative losses at petroleum bulk storage terminals, solvent evaporation from paints and varnishes, and solvent evaporation from dry cleaning.

C. USE OF THE INVENTORY

The data presented in this survey are not to be interpreted as absolute values. The pollutant emissions obtained should be considered as estimates to be used in defining the extent and distribution of air pollutant emissions in South Dakota. The data are accurate enough to be used in conjunction with ambient air quality measurements in the preparation of an implementation plan for meeting national ambient air standards.

II. SUMMARY

Tables 2 through 7 summarize the results of the emissions inventory program for South Dakota. Emissions from all pollutant source categories are presented and totalled for each of the Air Quality Control Regions as well as for the two principal urban centers; Sioux Falls and Rapid City.

Examination of these tables indicates that the primary source of particulate emissions is process losses from industrial point sources (II-B in Tables 2 through 7). These include mining and stone quarrying; cement and asphalt batch plants; and terminal and country grain elevators. These emissions, together with particulate emissions from grain elevators not responding to the questionnaires (classified in these tables under miscellaneous area sources) constitute well over 50% of the total particulate emissions in each of the four Air Quality Control Regions as well as Rapid City. The largest urban center, Sioux Falls, does not include many of these industries within its city limits and so particulate emissions are more evenly balanced between process losses, stationary fuel combustion and transportation.

As seen from Tables 2 through 7, sulfur dioxide emissions are produced from a wide variety of source categories. Coal combustion is the primary source, accounting for 32% of the SO_2 emissions in the state, yet it is utilized by only 7 steam-electric power plants and a few industrial and institutional establishments. The distillate oil used for residential heating in the state accounts for about 23% of the total SO_2 emissions. The remaining emissions of SO_2 are evenly distributed between commercial-institutional-industrial fuel oil (21%) and transportation sources (21%). SO_2 emissions from solid waste disposal are minimal, accounting for approximately 3% of the state total.

The primary sources of carbon monoxide (CO), hydrocarbons and oxides of nitrogen (NO_x) emissions are gasoline powered motor vehicles and off-highway gasoline primarily utilized as a fuel for farm tractors. However, process losses from point source petroleum bulk storage facilities,

dry cleaning establishments, and solvent evaporation from surface coatings, also significantly contribute to hydrocarbon emissions in South Dakota. Carbon monoxide and hydrocarbon emissions from solid waste disposal may also be significant, accounting for 10% of their respective total emissions in Region 205, but significantly less (< 5%) in the other 3 regions and in Sioux Falls and Rapid City.

TABLE 2

EMISSIONS INVENTORY SUMMARY FOR THE STATE OF SOUTH DAKOTA

AIR QUALITY CONTROL REGION 086

DATA REPRESENTATIVE OF CALENDAR YEAR 1970

	TONS OF POLLUTANT/YEAR					[illegible]	
	Particulate	SO_2	CO	HC	NO_x	Quantity	Units
I. FUEL COMBUSTION							
A. RESIDENTIAL FUEL-AREA SOURCE							
1. (ANTHRACITE) COAL	0	0	0	0	0		
2. DISTILLATE OIL	4	47	2	1	5	868	10^3 gal/yr
3. NATURAL GAS	2	0	2	1	9	242	10^6 cu ft/yr
4. WOOD	0	0	0	0	0		
5. LPG	3	0	3	1	10		
6. TOTAL	9	47	7	3	24		
B. COMM-INSTL & IND							
1a. (BITUMINOUS) COAL-AREA SOURCE	0	0	0	0	0		
b. (BITUMINOUS) COAL-POINT SOURCE	0	0	0	0	0		
2. COKE-POINT SOURCE	0	0	0	0	0		
3a. DISTILLATE OIL-AREA SOURCE	7	47	0	1	26	876	10^3 gal/yr
b. DISTILLATE OIL-POINT SOURCE	0	0	0	0	0		
4a. RESIDUAL OIL-AREA SOURCE	0	0	0	0	0		
b. RESIDUAL OIL-POINT SOURCE	0	0	0	0	0		
5a. NATURAL GAS-AREA SOURCE	1	0	1	0	5	354	10^6 cu ft/yr
b. NATURAL GAS-POINT SOURCE	0	0	0	0	0		
6. PROCESS GAS-POINT SOURCE	0	0	0	0	0		
7a. WOOD-AREA SOURCE	0	0	0	0	0		
b. WOOD-POINT SOURCE	0	0	0	0	0		
8. LPG-AREA SOURCE	1	0	1	0	1		
9. TOTAL	9	47	2	1	34		
C. STEAM-ELECTRIC POWER PLANT							
1. ANTHRACITE COAL	0	0	0	0	0		
2. BITUMINOUS COAL	0	0	0	0	0		
3. DISTILLATE OIL	0	0	0	0	0		
4. RESIDUAL OIL	0	0	0	0	0		
5. NATURAL GAS	0	0	0	0	0		
6. TOTAL	0	0	0	0	0		
D. TOTAL FUEL COMBUSTION	18	94	9	4	58		
II. PROCESS LOSSES							
A. AREA SOURCES	0	0	0	160	0		
B. POINT SOURCES	331	0	0	0	0		
III. SOLID WASTE DISPOSAL							
A. INCINERATION							
1a. ON SITE-AREA SOURCE	11	2	15	5	5	3,086	tons/yr
b. ON SITE-POINT SOURCE	0	0	0	0	0		
2. MUNICIPAL ETC.- POINT SOURCE	0	0	0	0	0		
B. OPEN BURNING							
1a. ON SITE-AREA SOURCE	49	3	261	92	18	6,136	tons/yr
b. ON SITE-POINT SOURCE	0	0	0	0	0		
2a. DUMPS - AREA SOURCE	0	0	0	0	0		
b. DUMPS - POINT SOURCE	26	1	133	45	10	3,110	tons/yr
C. CONICAL BURNERS - POINT SOURCE	0	0	0	0	0		
D. TOTAL SOLID WASTE DISPOSAL	86	6	409	142	33	12,332	tons/yr
IV. TRANSPORTATION-AREA SOURCE							
A 1. MOTOR VEHICLES-GASOLINE	39	23	9,170	1,372	1,295	1,915	10^3 V-M/yr
2. MOTOR VEHICLES-DIESEL	13	23	165	33	173	1,013	10^3 gal/yr
B. OFF-HIGH FUEL USAGE							
1. DIESEL	4	8	56	11	59	345	10^3 gal/yr
2. GASOLINE	6	4	2,500	333	177	1,515	10^3 gal/yr
C. AIRCRAFT	0	0	0	0	0		
D. RAILROADS	3	8	9	6	9	250	10^3 gal/yr
E. GASOLINE HANDLING EVAP. LOSSES	0	0	0	130	0		
F. TOTAL TRANSPORTATION	65	66	11,900	1,865	1,713		
V. MISCELLANEOUS-AREA SOURCES							
A. AGRICULTURAL BURNING	0	0	0	0	0		
B. GRAIN ELEVATORS	102	0	0	0	0		
VI. GRAND TOTAL							
A. AREA SOURCE	245	165	12,185	2,126	1,794		
B. POINT SOURCE	357	1	133	45	10		
C. TOTAL	602	166	12,318	2,171	1,804		

TABLE 3

EMISSIONS INVENTORY SUMMARY FOR THE STATE OF SOUTH DAKOTA

AIR QUALITY CONTROL REGION 087

DATA REPRESENTATIVE OF CALENDAR YEAR 1970

	TONS OF POLLUTANT/YEAR					[illegible]	
	Particulate	SO_2	CO	HC	NO_x	Quantity	Units
I. FUEL COMBUSTION							
A. RESIDENTIAL FUEL-AREA SOURCE	0	0	0	0	0		
1. (ANTHRACITE) COAL	37	391	18	11	44	7,255	10^3 gal/yr
2. DISTILLATE OIL	39	1	41	16	155	4,109	10^6 cu ft/yr
3. NATURAL GAS	0	0	0	0	0		
4. WOOD	22	0	25	10	87		
5. LPG	98	392	84	37	286		
6. TOTAL							
B. COMM-INSTL & IND	0	0	0	0	0		
1a. (BITUMINOUS) COAL-AREA SOURCE	12	18	1	0	10	1,088	tons/yr
b. (BITUMINOUS) COAL-POINT SOURCE	0	0	0	0	0		
2. COKE-POINT SOURCE	32	231	5	7	173	8,910	10^3 gal/yr
3a. DISTILLATE OIL-AREA SOURCE	70	348	1	14	279	9,308	10^3 gal/yr
b. DISTILLATE OIL-POINT SOURCE	0	0	0	0	0		
4a. RESIDUAL OIL-AREA SOURCE	15	206	0	4	79	2,639	10^3 gal/yr
b. RESIDUAL OIL-POINT SOURCE	32	0	0	24	154	3,117	
5a. NATURAL GAS-AREA SOURCE	10	0	10	7	51	1,144	10^6 cu ft/yr
b. NATURAL GAS-POINT SOURCE	0	0	0	0	0		
6. PROCESS GAS-POINT SOURCE	0	0	0	0	0		
7a. WOOD-AREA SOURCE	0	0	0	0	0		
b. WOOD-POINT SOURCE	6	0	1	2	22		
8. LPG-AREA SOURCE	177	803	23	58	768		
9. TOTAL							
C. STEAM-ELECTRIC POWER PLANT	0	0	0	0	0		
1. ANTHRACITE COAL	271	1,329	24	10	263	31,806	tons/yr
2. BITUMINOUS COAL	0	0	0	0	0		
3. DISTILLATE OIL	44	1,054	0	28	578	11,003	10^3 gal/yr
4. RESIDUAL OIL	13	1	1	54	522	2,678	10^6 cu ft/yr
5. NATURAL GAS	328	2,384	25	92	1,365		
6. TOTAL							
D. TOTAL FUEL COMBUSTION	603	3,579	132	187	2,417		
II. PROCESS LOSSES	0	0	0	2,034	0		
A. AREA SOURCES	7,395	0	27	3,706	0		
B. POINT SOURCES							
III. SOLID WASTE DISPOSAL							
A. INCINERATION	85	19	122	37	37	24,598	tons/yr
1a. ON SITE-AREA SOURCE	0	0	0	0	0		
b. ON SITE-POINT SOURCE	0	0	0	0	0		
2. MUNICIPAL ETC.- POINT SOURCE	394	24	2,091	739	148	49,200	tons/yr
B. OPEN BURNING	0	0	0	0	0		
1a. ON SITE-AREA SOURCE	0	0	0	0	0		
b. ON SITE-POINT SOURCE	70	2	379	137	27	9,806	tons/yr
2a. DUMPS - AREA SOURCE	0	0	0	0	0		
b. DUMPS - POINT SOURCE	549	45	2,592	913	212	82,604	tons/yr
C. CONICAL BURNERS - POINT SOURCE							
D. TOTAL SOLID WASTE DISPOSAL							
IV. TRANSPORTATION-AREA SOURCE	249	150	71,643	10,197	7,834	751,390	10^3 V-M/yr
A 1. MOTOR VEHICLES-GASOLINE	81	146	1,051	210	1,101	6,468	10^3 gal/yr
2. MOTOR VEHICLES-DIESEL							
B. OFF-HIGH FUEL USAGE	24	42	307	62	320	1,886	10^3 gal/yr
1. DIESEL	33	20	13,663	1,821	967	8,281	10^3 gal/yr
2. GASOLINE	86	20	123	366	80		
C. AIRCRAFT	18	46	50	35	33	1,423	10^3 gal/yr
D. RAILROADS	0	0	0	820	0		
E. GASOLINE HANDLING EVAP. LOSSES	491	424	86,837	13,381	10,375		
F. TOTAL TRANSPORTATION							
V. MISCELLANEOUS-AREA SOURCES	0	0	0	0	0		
A. AGRICULTURAL BURNING	646	0	0	0	0		
B. GRAIN ELEVATORS							
VI. GRAND TOTAL	1,784	1,090	89,146	16,281	11,193		
A. AREA SOURCE	7,900	2,958	443	3,960	1,909		
B. POINT SOURCE	9,684	4,048	89,589	20,241	13,004		
C. TOTAL							

TABLE 4

EMISSIONS INVENTORY SUMMARY FOR THE STATE OF SOUTH DAKOTA

AIR QUALITY CONTROL REGION 205

DATA REPRESENTATIVE OF CALENDAR YEAR 1970

	TONS OF POLLUTANT/YEAR					FUEL USE:	
	Particulate	SO_2	CO	HC	NO_x	Quantity	Units
I. FUEL COMBUSTION							
A. RESIDENTIAL FUEL-AREA SOURCE							
1. (ANTHRACITE) COAL	0	0	0	0	0		
2. DISTILLATE OIL	41	435	20	12	49	8,060	10^3 gal/yr
3. NATURAL GAS	26	1	28	11	103	2,748	10^6 cu ft/yr
4. WOOD	0	0	0	0	0		
5. LPG	26	0	27	10	97		
6. TOTAL	93	436	75	33	249		
B. COMM-INSTL & IND							
1a. (BITUMINOUS) COAL-AREA SOURCE	0	0	0	0	0		
b. (BITUMINOUS) COAL-POINT SOURCE	896	440	25	12	187	24,937	tons/yr
2. COKE-POINT SOURCE	0	0	0	0	0		
3a. DISTILLATE OIL-AREA SOURCE	69	109	0	12	269	8,903	10^3gal/yr
b. DISTILLATE OIL-POINT SOURCE	4	7	0	0	15	4,901	10^3 gal/yr
4a. RESIDUAL OIL-AREA SOURCE	0	0	0	0	0		
b. RESIDUAL OIL-POINT SOURCE	0	0	0	0	0		
5a. NATURAL GAS-AREA SOURCE	42	1	35	32	208	4,425	10^6 cu ft/yr
b. NATURAL GAS-POINT SOURCE	15	0	0	33	144	1,641	10^6 cu ft/yr
6. PROCESS GAS-POINT SOURCE	0	0	0	0	0		
7a. WOOD-AREA SOURCE	0	0	0	0	0		
b. WOOD-POINT SOURCE	0	0	0	0	0		
8. LPG-AREA SOURCE	6	0	7	3	24		
9. TOTAL	1,032	557	67	92	847		
C. STEAM-ELECTRIC POWER PLANT							
1. ANTHRACITE COAL	0	0	0	0	0		
2. BITUMINOUS COAL	838	1,280	135	186	3,273	182,008	tons/yr
3. DISTILLATE OIL	0	0	0	0	1	31	10^3 gal/yr
4. RESIDUAL OIL	0	0	0	0	0		
5. NATURAL GAS	0	0	0	0	0	2	10^6 cu ft/yr
6. TOTAL	838	1,280	135	186	3,274		
D. TOTAL FUEL COMBUSTION	1,963	2,273	277	311	4,370		
II. PROCESS LOSSES							
A. AREA SOURCES	0	0	0	1,885	0		
B. POINT SOURCES	19,809	0	0	544	3		
III. SOLID WASTE DISPOSAL							
A. INCINERATION	89	19	128	38	38	25,629	tons/yr
1a. ON SITE-AREA SOURCE	1	1	5	2	2	4,368	tons/yr
b. ON SITE-POINT SOURCE	0	0	0	0	0		
2. MUNICIPAL ETC.- POINT SOURCE							
B. OPEN BURNING	421	24	2,178	769	154	51,260	tons/yr
1a. ON SITE-AREA SOURCE	0	0	0	0	0		
b. ON SITE-POINT SOURCE	0	0	0	0	0		
2a. DUMPS - AREA SOURCE	211	15	1,127	398	77	26,413	tons/yr
b. DUMPS - POINT SOURCE	208	4	4,413	375	35	68,364	tons/yr
C. CONICAL BURNERS - POINT SOURCE	920	63	7,851	1,582	306		
D. TOTAL SOLID WASTE DISPOSAL							
IV. TRANSPORTATION-AREA SOURCE	236	144	62,993	9,126	7,603	713,310	10^3 V-M/yr
A 1. MOTOR VEHICLES-GASOLINE	77	139	996	200	1,044	6,139	10^3 gal/yr
2. MOTOR VEHICLES-DIESEL							
B. OFF-HIGH FUEL USAGE	12	20	150	30	156	921	10^3 gal/yr
1. DIESEL	16	10	6,665	889	471	4,039	10^3 gal/yr
2. GASOLINE	40	10	78	240	38		
C. AIRCRAFT	21	55	59	42	65	1,704	10^3 gal/yr
D. RAILROADS	0	0	0	613	0		
E. GASOLINE HANDLING EVAP. LOSSES	402	378	70,941	11,142	9,377		
F. TOTAL TRANSPORTATION							
V. MISCELLANEOUS-AREA SOURCES	0	0	0	0	0		
A. AGRICULTURAL BURNING	306	0	0	0	0		
B. GRAIN ELEVATORS							
VI. GRAND TOTAL	1,418	967	73,364	13,914	10,319		
A. AREA SOURCE	21,982	1,747	5,705	1,550	3,737		
B. POINT SOURCE	23,400	2,714	79,069	15,464	14,056		
C. TOTAL							

TABLE 5

EMISSIONS INVENTORY SUMMARY FOR THE STATE OF SOUTH DAKOTA

AIR QUALITY CONTROL REGION 206

DATA REPRESENTATIVE OF CALENDAR YEAR 1970

	TONS OF POLLUTANT/YEAR					FUEL USE:	
	Particulate	SO_2	CO	HC	NO_x	Quantity	Units
I. FUEL COMBUSTION							
A. RESIDENTIAL FUEL-AREA SOURCE	0	0	0	0	0		
1. (ANTHRACITE) COAL	229	2,474	115	69	275	45,818	10^3 gal/yr
2. DISTILLATE OIL	38	1	40	16	150	3,992	10^6 cu ft/yr
3. NATURAL GAS	0	0	0	0	0		
4. WOOD	148	0	155	59	548		
5. LPG	415	2,475	310	144	973		
6. TOTAL							
B. COMM-INSTL & IND	0	0	0	0	0		
1a. (BITUMINOUS) COAL-AREA SOURCE	41	505	10	5	69	9,225	tons/yr
b. (BITUMINOUS) COAL-POINT SOURCE	0	0	0	0	0		
2. COKE-POINT SOURCE	374	359	5	75	1,497	49,906	10^3 gal/yr
3a. DISTILLATE OIL-AREA SOURCE	34	301	0	5	142	4,751	10^3 gal/yr
b. DISTILLATE OIL-POINT SOURCE	0	0	0	0	0		
4a. RESIDUAL OIL-AREA SOURCE	14	199	0	1	39	1,267	10^3 gal/yr
b. RESIDUAL OIL-POINT SOURCE	41	2	20	58	293	4,509	10^6 cu ft
5a. NATURAL GAS-AREA SOURCE	2	0	4	2	20	449	10^6 cu ft/yr
b. NATURAL GAS-POINT SOURCE	0	0	0	0	0		
6. PROCESS GAS-POINT SOURCE	0	0	0	0	0		
7a. WOOD-AREA SOURCE	0	0	0	0	0		
b. WOOD-POINT SOURCE	37	0	19	15	137		
8. LPG-AREA SOURCE	543	1,366	78	161	2,197		
9. TOTAL							
C. STEAM-ELECTRIC POWER PLANT	0	0	0	0			
1. ANTHRACITE COAL	646	989	70	35	320	69,175	tons/yr
2. BITUMINOUS COAL	14	65	0	3	55	1,801	10^3 gal/yr
3. DISTILLATE OIL	1	19	0	0	7	139	10^3 gal/yr
4. RESIDUAL OIL	7	0	2	32	275	1,775	10^6 cu ft/yr
5. NATURAL GAS	668	1,073	72	70	857		
6. TOTAL							
D. TOTAL FUEL COMBUSTION	1,626	4,914	460	375	4,027		
II. PROCESS LOSSES	0	0	0	6,925	0		
A. AREA SOURCES	10,123	0	3	2,407	0		
B. POINT SOURCES							
III. SOLID WASTE DISPOSAL							
A. INCINERATION	387	83	553	166	166	110,581	tons/yr
1a. ON SITE-AREA SOURCE	10	2	14	10	2	5,242	tons/yr
b. ON SITE-POINT SOURCE	0	0	0	0	0		
2. MUNICIPAL ETC.- POINT SOURCE							
B. OPEN BURNING	1,769	111	9,400	3,318	664	221,178	tons/yr
1a. ON SITE-AREA SOURCE	0	0	0	0	0		
b. ON SITE-POINT SOURCE	0	0	0	0	0		
2a. DUMPS - AREA SOURCE	1,271	65	6,837	2,421	465	139,348	tons/yr
b. DUMPS - POINT SOURCE	0	0	0	0	0		
C. CONICAL BURNERS - POINT SOURCE	3,437	261	16,804	5,915	1,297		
D. TOTAL SOLID WASTE DISPOSAL							
IV. TRANSPORTATION-AREA SOURCE	872	528	217,463	32,055	28,627	2,640,930	10^3 V-M/yr
A 1. MOTOR VEHICLES-GASOLINE	284	511	3,693	739	3,864	22,729	10^3 gal/yr
2. MOTOR VEHICLES-DIESEL							
B. OFF-HIGH FUEL USAGE	248	447	3,225	645	3,374	19,849	10^3 gal/yr
1. DIESEL	359	218	143,778	19,170	10,184	87,138	10^3 gal/yr
2. GASOLINE	95	17	82	218	83		
C. AIRCRAFT	141	368	396	283	424	11,319	10^3 gal/yr
D. RAILROADS	0	0	0	1,038	0		
E. GASOLINE HANDLING EVAP. LOSSES	1,999	2,089	368,637	56,148	46,556		
F. TOTAL TRANSPORTATION							
V. MISCELLANEOUS-AREA SOURCES	0	0	0	0	0		
A. AGRICULTURAL BURNING	6,736	0	0	0	0		
B. GRAIN ELEVATORS							
VI. GRAND TOTAL	11,758	5,119	378,984	66,849	50,286		
A. AREA SOURCE	12,163	2,145	6,960	4,921	1,594		
B. POINT SOURCE	23,921	7,264	385,904	71,770	51,880		
C. TOTAL							

TABLE 6

EMISSIONS INVENTORY SUMMARY FOR THE STATE OF SOUTH DAKOTA

CITY OF SIOUX FALLS

DATA REPRESENTATIVE OF CALENDAR YEAR 1970

	TONS OF POLLUTANT/YEAR					FUEL ETC.	
	Particulate	SO_2	CO	HC	NO_x	Quantity	Units
I. FUEL COMBUSTION							
A. RESIDENTIAL FUEL-AREA SOURCE							
1. (ANTHRACITE) COAL	0	0	0	0	0		
2. DISTILLATE OIL	5	59	3	2	7	1,087	10^3 gal/yr
3. NATURAL GAS	33	1	35	14	130	3,470	10^6 cu ft/yr
4. WOOD	0	0	0	0	0		
5. LPG	3	0	4	2	13		
6. TOTAL	41	60	42	18	150		
B. COMM-INSTL & IND							
1a. (BITUMINOUS) COAL-AREA SOURCE	0	0	0	0	0		
b. (BITUMINOUS) COAL-POINT SOURCE	13	18	1	0	10	1,088	tons/yr
2. COKE-POINT SOURCE	0	0	0	0	0		
3a. DISTILLATE OIL-AREA SOURCE	13	92	0	2	51	1,708	10^3 gal/yr
b. DISTILLATE OIL-POINT SOURCE	70	349	1	15	279	9,308	10^3 gal/yr
4a. RESIDUAL OIL-AREA SOURCE	0	0	0	0	0		
b. RESIDUAL OIL-POINT SOURCE	5	71	0	3	53	1,795	10^3 gal/yr
5a. NATURAL GAS-AREA SOURCE	26	1	17	28	155	2,737	10^6 cu ft/yr
b. NATURAL GAS-POINT SOURCE	9	0	9	6	53	1,144	10^6 cu ft/yr
6. PROCESS GAS-POINT SOURCE	0	0	0	0	0		
7a. WOOD-AREA SOURCE	0	0	0	0	0		
b. WOOD-POINT SOURCE							
8. LPG-AREA SOURCE	1	0	1	0	3		
9. TOTAL	137	531	29	54	604		
C. STEAM-ELECTRIC POWER PLANT							
1. ANTHRACITE COAL	0	0	0	0	0		
2. BITUMINOUS COAL	0	0	0	0	0		
3. DISTILLATE OIL	0	0	0	0	0		
4. RESIDUAL OIL	0	16	0	0	6	115	10^3 gal/yr
5. NATURAL GAS	0	0	0	0	4	19	10^6 cu ft/yr
6. TOTAL	0	16	0	0	10		
D. TOTAL FUEL COMBUSTION	178	607	71	72	784		
II. PROCESS LOSSES	0	0	0	1,199	0		
A. AREA SOURCES	171	0	27	2,237	0		
B. POINT SOURCES							
III. SOLID WASTE DISPOSAL							
A. INCINERATION	59	13	84	25	25	16,843	tons/yr
1a. ON SITE-AREA SOURCE	0	0	0	0	0		
b. ON SITE-POINT SOURCE	0	0.	0	0	0		
2. MUNICIPAL ETC.- POINT SOURCE							
B. OPEN BURNING	0	0	0	0	0		
1a. ON SITE-AREA SOURCE	0	0	0	0	0		
b. ON SITE-POINT SOURCE	0	0	0	0	0		
2a. DUMPS - AREA SOURCE	0	0	0	0	0		
b. DUMPS - POINT SOURCE	0	0	0	0	0		
C. CONICAL BURNERS - POINT SOURCE	59	13	84	25	25	16,843	tons/yr
D. TOTAL SOLID WASTE DISPOSAL							
IV. TRANSPORTATION-AREA SOURCE	83	50	33,052	4,407	2,341	230,391	10^3 V-M/yr
A 1. MOTOR VEHICLES-GASOLINE	64	115	830	186	869	5,110	10^3 gal/yr
2. MOTOR VEHICLES-DIESEL							
B. OFF-HIGH FUEL USAGE	0	0	0	0	0	0	
1. DIESEL	0	0	0	0	0	0	
2. GASOLINE	86	20	123	366	80		
C. AIRCRAFT	4	10	11	8	12	320	10^3 gal/yr
D. RAILROADS	0	0	0	363	0		
E. GASOLINE HANDLING EVAP. LOSSES							
F. TOTAL TRANSPORTATION	237	195	34,016	5,310	3,302		
V. MISCELLANEOUS-AREA SOURCES	0	0	0	0	0		
A. AGRICULTURAL BURNING	0	0	0	0	0		
B. GRAIN ELEVATORS							
VI. GRAND TOTAL	377	361	34,160	6,582	3,686		
A. AREA SOURCE	268	454	38	2,261	405		
B. POINT SOURCE	645	815	34,198	8,843	4,091		
C. TOTAL							

TABLE 7

EMISSIONS INVENTORY SUMMARY FOR THE STATE OF SOUTH DAKOTA

CITY OF RAPID CITY

DATA REPRESENTATIVE OF CALENDAR YEAR 1970

	TONS OF POLLUTANT/YEAR					[illegible]	
	Particulate	SO_2	CO	HC	NO_x	Quantity	Units
I. FUEL COMBUSTION							
A. RESIDENTIAL FUEL-AREA SOURCE							
1. (ANTHRACITE) COAL	0	0	0	0	0		
2. DISTILLATE OIL	3	35	2	1	4	636	10^3 gal/yr
3. NATURAL GAS	17	1	18	7	66	1,769	10^6 cu ft/yr
4. WOOD	0	0	0	0	0		
5. LPG	2	0	2	1	8		
6. TOTAL	22	36	22	9	78		
B. COMM-INSTL & IND							
1a. (BITUMINOUS) COAL-AREA SOURCE	0	0	0	0	0		
b. (BITUMINOUS) COAL-POINT SOURCE	0	0	0	0	0		
2. COKE-POINT SOURCE	0	0	0	0	0		
3a. DISTILLATE OIL-AREA SOURCE	6	43	0	1	24	794	10^3 gal/yr
b. DISTILLATE OIL-POINT SOURCE	0	0	0	0	0		
4a. RESIDUAL OIL-AREA SOURCE	0	0	0	0	0		
b. RESIDUAL OIL-POINT SOURCE	0	0	0	0	0		
5a. NATURAL GAS-AREA SOURCE	28	1	25	19	132	2,921	10^6 cu ft/yr
b. NATURAL GAS-POINT SOURCE	0	0	0	0	0		
6. PROCESS GAS-POINT SOURCE	0	0	0	0	0		
7a. WOOD-AREA SOURCE	0	0	0	0	0		
b. WOOD-POINT SOURCE	0	0	0	0	0		
8. LPG-AREA SOURCE	1	0	1	0	2		
9. TOTAL	35	44	26	20	158		
C. STEAM-ELECTRIC POWER PLANT							
1. ANTHRACITE COAL	0	0	0	0	0		
2. BITUMINOUS COAL	348	671	48	14	2,624	95,421	tons/yr
3. DISTILLATE OIL	0	0	0	0	1	31	10^3 gal/yr
4. RESIDUAL OIL	0	0	0	0	0		
5. NATURAL GAS	0	0	0	0	0		
6. TOTAL	348	671	48	14	2,625		
D. TOTAL FUEL COMBUSTION	405	751	96	43	2,861		
II. PROCESS LOSSES							
A. AREA SOURCES	0	0	0	723	0		
B. POINT SOURCES	1,032	0	0	20	0		
III. SOLID WASTE DISPOSAL							
A. INCINERATION							
1a. ON SITE-AREA SOURCE	73	16	104	31	31	20,740	tons/yr
b. ON SITE-POINT SOURCE	0	0	0	0	0		
2. MUNICIPAL ETC.- POINT SOURCE	0	0	0	0	0		
B. OPEN BURNING							
1a. ON SITE-AREA SOURCE	0	0	0	0	0		
b. ON SITE-POINT SOURCE	0	0	0	0	0		
2a. DUMPS - AREA SOURCE	0	0	0	0	0		
b. DUMPS - POINT SOURCE	0	0	0	0	0		
C. CHEMICAL BURNERS - POINT SOURCE	0	0	0	0	0		
D. TOTAL SOLID WASTE DISPOSAL	73	16	104	31	31		
IV. TRANSPORTATION-AREA SOURCE							
A 1. MOTOR VEHICLES-GASOLINE	43	26	17,067	2,276	1,209	139,295	10^3 V-M/yr
2. MOTOR VEHICLES-DIESEL	33	39	439	84	449	2,659	10^3 gal/yr
B. OFF-HIGH FUEL USAGE							
1. DIESEL	0	0	0	0	0		
2. GASOLINE	0	0	0	0	0		
C. AIRCRAFT	0	0	0	5	8	205	10^3 gal/yr
D. RAILROADS	3	7	7	320	0		
E. GASOLINE HANDLING EVAP. LOSSES	0	0	0	[illegible]	0		
F. TOTAL TRANSPORTATION	79	92	17,583	[illegible]	1,666		
V. MISCELLANEOUS-AREA SOURCES							
A. AGRICULTURAL BURNING	34	0	0	0	0		
B. GRAIN ELEVATORS							
VI. GRAND TOTAL							
A. AREA SOURCE	243	188	17,635	3,402	1,923		
B. POINT SOURCE	1,380	671	48	34	2,625		
C. TOTAL	1,623	859	17,703	3,436	4,548		

III. AREA DESCRIPTION

South Dakota is the 16th largest state in the Union. Its 77,047 square miles are divided into four geographic regions. From east to west, these are the Young Drift Plain, the Dissected Till, the Great Plains and the Black Hills. The Young Drift Plain covering the eastern part of the state, is mainly an agricultural area. Products include rye, wheat, and livestock. The Dissected Till, in the southeast corner of the state, like the Young Drift Plains is basically agricultural; however, most of the states' food processing industry is located in this region. The Great Plains, covering the western half of the state, is a moderately fertile area. Although wheat and some other grains are grown there, it is basically a livestock grazing area. In the southwest corner of the state in the Black Hills, the mining and lumber production industries are located.

The meteorological data of the area show that it is a cool dry area with good ambient air circulation. The average high temperature for July is 88 degrees, while the average low in January is 10 degrees. For a given year the average number of degree days (a measure of heating requirements) is 7500. The average yearly precipitation is 18 inches. Due to the different land patterns in the state, no single statement can be made about prevailing winds; however, from the air pollution standpoint, the number of days with no wind (calm conditions) is important. In South Dakota this averages about 5 percent. In comparison, Los Angeles, a city with significant air pollution problems, averages about 13 percent calm days during the year.

IV. METHODOLOGY

A. DEFINITION OF POINT AND AREA SOURCES

This emissions inventory considers two classifications of emissions sources , point and area sources. Point sources are generally large establishments whose emissions are significant enough to warrant individual consideration. On the other hand, sources whose emissions are too small to be considered individually are accounted for collectively as an area source.

1. Point Sources

The Federal Register (Volume 36, No. 67, Part II, Appendix C) lists those major pollutant source categories which are to be classified as point sources, independent of size. South Dakota contains the following industrial categories which are included in the Federal listing.

Alfalfa Dehydrating
Feed and Grain Handling and Processing
Meat Smoke Houses
Asphaltic Concrete Batching
Bricks and Related Clay Refractories
Cement
Concrete Batching
Lime Manufacturing
Rock, Gravel and Sand Quarrying and Processing
Open Burning Dumps
Steam Electric Power Plants
Petroleum Bulk Storage Terminals
Wood Processing - Conical Wood Burners

In addition to the above industrial classifications, all fuel combustion sources were considered point sources if one or more of the following air pollution emission criteria were met.

- Annual Particulate Emissions of 5 tons or greater
- Annual Sulfur Dioxide Emissions of 10 tons or greater
- Annual Nitrogen Oxide Emissions of 25 tons or greater.

2. Area Sources

Area sources are defined as those combustion and process sources which in themselves are too small to constitute a point source,

but when considered collectively, will significantly contribute to the total emissions of the study area.

The following presents a listing of those categories considered as area sources in South Dakota. These categories, however, exclude those individual sources which have emissions large enough to classify them as point sources.

Fuel Combustion - Stationary Sources

Residential - combustion of distillate oil, natural gas and liquid petroleum gas (LPG) accounts for emissions from residential heating. Coal is no longer utilized in South Dakota for residential heating.

Commercial and Institutional - area source emissions in this category result from the combustion of distillate and residual fuel oil, natural gas and LPG. The coal used in South Dakota in this category is essentially all accounted for by point sources.

Industrial - area source emissions in this category result from the combustion of distillate oil, residual oil and natural gas. Essentially all the industrial coal utilized is accounted for by point sources.

Process Losses

Dry cleaning establishments

Utilization of Paints and varnishes

Grain Elevators - This category only includes those elevators that did not return questionnaires. For these non-responding sources, emissions were estimated based on information obtained from returned questionnaires, and included as an area source.

Solid Waste Disposal

On Site Burning of Municipal Refuse

On Site Incineration of Municipal Refuse

Transportation

Motor Vehicles - both gasoline and diesel powered vehicles are included.

Locomotives

Aircraft

Tractors - tractors are the major off-highway consumer of both diesel. oil and gasoline

Evaporative Losses from Gasoline Marketing

B. POINT SOURCES

1. Data Collection

a. Preparation of Mailing List

Based on the above definition of point sources in South Dakota, a mailing list was developed and questionnaires sent out. Table 8 presents a listing of references utilized in developing this mailing list. Copies of the questionnaires are presented in the appendix.

As discussed earlier, a fuel combustion source, other than specified in the Federal listing of major industrial categories, was classified as a point source if its annual emission levels for particulate, SO_2, or NO_x was equal to or greater than 5, 10, and 25 tons respectively. In compiling this mailing list, however, there were several categories (such as schools, hospitals, hotels, a variety of residential, commercial, institutional, Federal and civic buildings, together with many miscellaneous industries) which because of a lack of information pertaining to the type and quantity of fuel consumed, could not definitely be classified as point sources. Working criteria for the completion of the point source mailing list were then established and are presenced below:

Manufacturing and Commercial Establishments	- more than 25 employees
Schools and Colleges	- more than 1000 students
Hospitals	- more than 50 beds
Hotels and Motels	- more than 100 rooms.

These criteria were modified as required in the light of knowledge of either State or GCA personnel as well as data available from the individual sources.

b. Response to Questionnaires

Table 9 summarizes the number of questionnaires sent out, the number returned, and percent of response. In addition, data are presented which list the number of questionnaires mailed to actual point sources only, as well as the number of these returned and percent response.

TABLE 8

LIST OF POINT SOURCE REFERENCES FOR SOUTH DAKOTA

1. Manufacturers and Processors Directory 1969 - 71
2. South Dakota Telephone Directory
3. Air Quality Control Section Complaint File
4. South Dakota Grain Elevator Licensed by Public Utilities Comm.
5. Department of Highways - Qualified Bidders Lists
6. Minerals Yearbook - Bureau of Mines, 1968
7. Health Department Correspondence File Guide
8. Mineral Facts and Problems, 1965, Bureau of Mines
9. Electrical World
10. Steam - Electric Plant Factors, 1968, National Coal Assoc., Washington, D.C.
11. Indian Health Services
12. South Dakota Hospital Licensed by South Dakota Department of Health
13. Nursing Homes Licensed by South Dakota Department of Health
14. South Dakota Lodging License Listings for 1970-71
15. South Dakota Department of Public Instruction, Public & Private School Listings
16. Educational Institutions of South Dakota Listings
17. South Dakota League for Nursing Careers Committee
18. Personal Communications with Assessors Offices of the following towns:
    - Sioux Falls
    - Rapid City
    - Brookings
    - Yankton
    - Watertown
    - Aberdeen
    - Mitchell
19. South Dakota Department of Agriculture - Div. of Plant Industry
20. Communicators with National Guard Office, Rapid City
21. South Dakota Highway Department - Approved Sources of Aggregate
22. South Dakota Department of Revenue

Table 9 shows that of the actual number of point source questionnaires mailed (Column 4), 58 percent were eventually completed and returned. Many of these questionnaires were initially sent in incomplete or with erroneous information. An extensive telephone re-contacting effort was made so that these questionnaires could be properly completed. In addition, all non-respondents in the following point source categories were recontacted.

Saw Mills
Concrete Batch Plants
Asphalt Batch Plants
Mining or Stone Processing
Crude Oil Drilling
Petroleum Bulk Storage Terminals
Steam Electric Generating Facilities
Meat Packing and Processing
Chemical Process Industry
Hospitals
Larger Schools and Manufacturers

The percent response to the point source questionnaires is summarized in Column 6 of Table 9. It is evident that an excellent response was obtained from all but two of the point source categories, namely, grain elevators and concrete batch plants. No attempt was made to estimate the emissions from the non-respondent concrete batch plants as emissions from those responding plants were generally less than or equal to one ton of particulate annually. However, for grain elevators, emissions from non-responding sites were estimated by using the average value obtained from the returned questionnaires. These estimates were then included as area source emissions.

No attempt was made to determine the emissions from the few non-responding point sources in the other categories. Their level of emissions was estimated to be relatively small compared with the emissions accounted for by the returned questionnaires.

2. Data Analysis

Analysis of the data from the completed questionnaires consisted of two essential phases: (a) the choice and use of a coordinate

TABLE 9

SUMMARY OF RESPONSE TO POINT SOURCE QUESTIONNAIRES

Category	Total No. of Quest. Sent	Total No. of Quest. Returned	Percent Response	No. of Point Source Quest. Sent	No. of Point Source Quest. Returned	Percent Response
Alfalfa Dehydrating	26	9	34.6	3	3	100.0
Grain Elevators	470	232	49.4	470	232	49.4
Saw Mills	26	22	84.6	12	10	83.3
Concrete Batch Plants	96	74	77.1	55	34	61.8
Asphalt Batch Plants	32	29	90.6	18	14	77.8
Mining or Stone Quarrying	60	47	78.3	34	29	85.3
Crude Oil Drilling	3	3	100.0	1	1	100.0
Petroleum Bulk Storage Terminals	11	11	100.0	11	11	100.0
Electric Generating Facilities	34	27	79.4	15	15	100.0
Meat Packing and Processing	48	32	66.7	4	4	100.0
Chemical Process Industry	7	7	100.0	0	0	-
Hospitals & Nursing Homes	110	59	53.6	8	8	100.0
Hotels & Motels (>50 units)	46	7	15.2	0	0	-
Schools (>1000 students)	70	32	45.7	11	10	90.9
Creameries and Dairies	35	14	40.0	1	1	100.0
Apartment, Commercial, Civic Buildings	31	9	29.0	0	0	-
Green Houses	8	4	50.0	0	0	-
Federal Facilities	22	18	81.8	1	1	100.0
Miscellaneous	77	49	63.6	1	1	100.0
	1212	685	56.5	645	374	58.0

system for defining the locations of point sources, and (b) the transforming of raw data from the questionnaires into the form required for input to the computer program used by the Office of Air Programs (OAP) for the final emissions inventory calculations.

a. Coordinate System

The Universal Transverse Mercator (UTM) coordinate system was chosen for South Dakota because: (a) the system is widely used in meteorological modeling, (b) maps with the UTM grids denoted are readily available from the U.S. Geological Survey (USGS), and (c) the UTM system does not suffer from grid irregularities to the same extent as do most other systems, notably the township/section system used in South Dakota. In general, the locations of individual point sources were determined to within one kilometer in either (flat projection) dimension.

b. Computer Input Forms

The details of the data manipulation required for data transformation will not be discussed here. Instead, some critical assumptions and statements of policy regarding data treatment will be reviewed in the following material.

i. Stack Parameters - information concerning stack heights, diameters, and flow conditions are given only for sources emitting 50 tons or more per year of any pollutant. In most cases where such data are given, they are based on estimates using OAP recommended procedures. The 50 tons per year cut-off point was recommended by OAP.

ii. Process Weights - in most cases, the respondents gave this information, but grain elevators generally did not. To obtain process weights for these sources, a grain-handling time of 1000 hours per year was assumed for country elevators, and 2000 hours per year for terminal elevators. These hours were based on phone conversations with with several grain elevator operators. Because sufficient data were not available from the questionnaires, maximum process weight was set equal to normal process weight.

iii. Fuel Characteristics - in almost all cases, these were given on the returned questionnaires. In those few cases where such data were not given, assumptions were made based on data from the returned questionnaires.

iv. Pollution Control Efficiency - major point sources gave control efficiencies almost without exception, but many smaller sources did not have such data. The values given by McGraw and Duprey(18) were normally used where the data were missing. However, be-

cause of the usual operating procedures at grain elevators, the dust houses frequently used were assumed to have a zero percent particulate removal efficiency.

v. Emissions - some respondents included estimates of actual emissions on their returned questionnaires. These data were used if they showed reasonable agreement with estimates obtained by the use of emission factors. Otherwise, the estimated values based on emission factors were used.

vi. Allowable Emission - allowable emissions of sulfur dioxide and particulates based on the Federal model standards (Federal Register, Volume 36, Number 67, Appendix B) were hand calculated for all regulated point sources in the state. The Federal model sulfur dioxide emission was calculated for combustion sources by assuming 80 percent removal.

C. AREA SOURCES

1. Area Source References

References used to develop state totals and apportion area source fuel, solid waste and process losses in South Dakota are summarized in Table 10. These references include both local and state data together with data compiled by private companies and by Federal agencies such as the Census Bureau and the Bureau of Mines.

2. Data Analysis

This section discusses the methodology utilized in estimating and apportioning fuel, solid waste and process area source emissions. Because a variety of area source categories utilize a number of different types of fuels, we have included Table 11 which summarizes those fuel consuming area source categories and the types of fuels utilized. The ensuing discussion of stationary fuel combustion and transportation area sources is based around this table.

a. Stationary Fuel Combustion

i. Coal

The Bureau of Mines[13] has published data for coal consumption in North and South Dakota combined, and no individual breakdown was available for these states. However, consumption totals from the point source questionnaires from both states, exceed the combined total

TABLE 10

LISTING OF AREA SOURCE REFERENCES FOR SOUTH DAKOTA

1. Montana - Dakota Utility Company
2. Northern Natural Gas
3. Central Telephone Utilities Corporation
4. Iowa Public Service Company
5. Northwestern Public Service Company
6. City of Watertown, South Dakota
7. South Dakota Oilmen's Association Annual Statistical Report, 1969-1970
8. South Dakota Agricultural Statistics, 1969
9. USDHEW - 1968 Survey of Community Solid Waste Practices - South Dakota
10. South Dakota Highway Department, 1970 Statistical Data on Gallons and Vehicle-Miles of Gasoline by County
11. South Dakota State Dept. of Revenue
12. Sales of Fuel Oil and Kerosene in 1969, Minerals Industry Surveys, U.S. Dept of Interior, Bureau of Mines, Washington, D.C.
13. Bituminous Coal and Lignite Distribution 1970, Minerals Industrial Survey, Bureau of Mines, Washington, D.C.
14. Census of Business - 1967, Wholesale Trade U.S. Dept of Commerce, Bureau of the Census
15. Census of Business - 1967, Retail Trade, U.S. Dept of Commerce, Bureau of the Census
16. Census Manufacture - 1963, U.S. Dept. of Commerce, Bureau of the Census
17. U.S. Census of Population and Housing - 1970 U.S. Dept. of Commerce, Washington, D.C.
18. McGraw, M.J., Duprey, R.L., "Air Pollutant Emission Factors-Preliminary Document," Environmental Protection Agency, Research Triangle Park, North Carolina, 1971
19. Airline Schedules for North Central, Frontier, Western & Ozark Airlines, 1971
20. Communications with Chicago Northwest, Great Northern, Milwaukee & Illinois Central Railroads, June 1971
21. Personal communication, Francis Schofield, U.S. Paint & Varnish Assoc., Wash. D.C.,6/21/71
22. Strock, C., Koral, R.L., Handbook of Air Conditioning, Heating & Ventilation, Industrial Press, New York, 1965.
23. 1968 LP-Gas Shipment Up 11.7%, LP-Gas December 1969, page 30.
24. Personal communication with Mr. Ray Rowell, Executive Secretary, Nebraska-South Dakota Liquified Petroleum Gas Assoc., June 1971
25. Vaughan, Richard D., National Solid Waste Survey Report Summary & Interpretation, Interim Report, 1968 National Survey of Community Solid Waste Practices, October 24, 1968, page 48.
26. Chansky, S.H. et al., Systems Study of Air Pollution From Municipal Incineration, U.S. D. of HEW, NAPCA, March 1970.

published by the Bureau of Mines. We have therefore concluded that all coal consumption in South Dakota was accounted for by point sources and that area source coal consumption (including residential coal) is insignificant. This is confirmed by communications with various state officials in the Health Dept. familiar with coal usage in South Dakota. All the point source coal reported is bituminous except for the Mobridge power plant (source No. 16, Region 206) which consumes a reported 33,680 tons/year of Lignite coal.

ii. Residual Oil

Returned questionnaires indicate that residual oil consumed by point sources exceeds the Bureau of Mines consumption total[12] for South Dakota. We have therefore concluded that residual oil consumption in South Dakota was accounted for by point sources and that area source residual oil consumption is essentially zero. This is confirmed by communications with various state officials familiar with residual oil usage in South Dakota.

iii. Distillate Oil

Total distillate oil utilized in South Dakota in 1970, except for that quantity consumed by railroads, was obtained from the Independent Oilmen's Association Annual Statistical Report.[7] This total included kerosene jet fuel, diesel fuel, and No. 1, 2, and 4 fuel oil. After subtracting out the keros ne and jet fuel consumed in the state in 1970,* the remaining distillate oil was apportioned to the following use categories, utilizing Bureau of Mines fuel oil consumption data for South Dakota:[12]

Commercial and Institutional Distillate Oil

The Bureau of Mines fuel oil consumption data did not allow for a breakdown between residential and commercial plus institutional usage. Residential heating requirements were estimated, based on the 1970 Bureau of Census data for housing units, the number of degree days per year (7500),[22] and the average annual heating requirements per home (24,000 BTU/degree day).[22]

*The independent Oilmen's Statistical report indicated that approximately 1 million gallons of kerosene are consumed annually. Data from Petroleum Bulk Storage terminals indicate that about 9.7 million gallons of aviation fuel was consumed in South Dakota in 1970.

The quantity of residential heat supplied by natural gas was then removed to give residential fuel oil consumption. This value was then subtracted from the total residential, commercial and institutional fuel oil consumption to obtain the distillate fuel oil consumed by commercial and institutional establishments in the State.

This total minus point source commercial and institutional consumption was next apportioned to the counties (as well as Sioux Falls and Rapid City) by the number of wholesale plus retail establishments obtained from the Bureau of Census.[14,15] These values were first adjusted to reflect those establishments NOT being serviced by natural gas.

Emissions were calculated based upon the emission factors presented in McGraw and Duprey's Compilation of Air Pollutant Emission Factors, 1971.[18] An average sulfur content of 0.75 percent was assumed, based on data from the point source questionnaires.

Residential Fuel Oil

The state consumption of kerosene was included in this total. The state usage was apportioned to the counties and the cities of Sioux Falls and Rapid City by population.[17] The county and city populations were adjusted to reflect the population NOT being serviced by natural gas.

Emissions were calculated based on the emission factors presented in McGraw and Duprey's Compilation of Air Pollutant Emission Factors, 1971.[18] An average fuel sulfur content of 0.75 percent was assumed, based on data from the point source questionnaires.

Industrial Distillate

State totals minus point source industrial consumption were apportioned to the counties and the two major cities by the number of manufacturing employees.[16] Again, these apportioning figures were adjusted to reflect those industries NOT being serviced by natural gas.

Emissions were calculated based upon the emission factors presented by McGraw and Duprey.[18]

On-Highway Diesel Fuel

Since this category is classified as a transportation source, the methodology discussion is presented in the following Section (IV.C.2.b.).

Off-Highway Diesel Fuel

Since this category is also classified as a transportation source, the methodology discussion is presented in the following section (IV.C.2.b.).

TABLE 11

AREA SOURCE CATEGORY VS. FUEL TYPE CONSUMED

Area Source Fuel Combustion Categories	Fuel Type							
			DISTILLATE					
	Coal	Residual Oil	Kerosene	Diesel	#1,2,& #4 oil	Natural Gas	Gasoline	LPG
Stationary Sources								
Residential	0	0	X	NA	X	X	NA	X
Commercial & Institutional	0	0	X	NA	X	X	NA	X
Industrial	0	0	0	NA	X	X	NA	0
Transportation								
Railroads	NA	X	NA	X	NA	NA	NA	NA
Motor Vehicles	NA	NA	NA	X	NA	NA	X	NA
Tractors	NA	NA	NA	X	NA	NA	X	NA
Aircraft	NA	NA	X	NA	NA	NA	X	NA

X = fuel is utilized by source category
0 = fuel is not utilized by source category
NA= not applicable

iv. Natural Gas

Natural gas is utilized in 25 counties in South Dakota including Minnehaha and Pennington counties which include the respective cities of Sioux Falls and Rapid City. Natural gas consumption data for 1970 were available by use category (residential, commercial plus institutional, and industrial) for these cities as well as the counties. The data were obtained from the three companies (Montana Dakota Utilities Co., Iowa Public Service Co., and Northern Natural Gas) supplying gas to South Dakota as well as from the utility companies distributing this gas.

Emissions were calculated based upon the emission factors presented in McGraw and Duprey's Compilation of Air Pollutant Emission Factors - 1971.[18]

v. LPG (Liquid Petroleum Gas)

State consumption totals were obtained from the Bureau of Mines[23] and apportioned by population data,[17] adjusted to reflect those NOT serviced by natural gas. Emissions were calculated based upon the emission factors for domestic and commercial propane as presented in McGraw and Duprey's Compilation of Air Pollutant Emission Factors - 1971.[18] The emission factor for nitrogen oxide was assumed to be 23 pounds per thousand gallons, based on the assumption that 80 percent of the LPG was utilized by domestic sources and 20 percent by commercial sources.[24]

b. Transportation

i. Gasoline-Powered Motor Vehicles

Urban and rural vehicle mile data for 1970 were available by county and for the cities of Sioux Falls and Rapid City.[10] We assumed that 98 percent of the vehicle miles were attributed to gasoline powered motor vehicles[18] and utilized the emission factors presented by McGraw and Duprey[18] to obtain county and city emissions from on-highway gasoline consumption.

ii. Off-Highway Gasoline (Farm tractors)

Total off-highway gasoline sold in 1970 (that quantity of gasoline which is tax exempt) was available from the state[1] and was assumed to be essentially all consumed by tractors. The data were therefore apportioned to the counties by crop-acres.[8] Emissions were calculated based upon the emission factors for gasoline powered motor vehicles traveling at 25 mph as presented in McGraw and Duprey's Compilation of Air Pollutant Emission Factors - 1971.[18] The values presented in this text were, however, adjusted by a factor of 12.5 v-m/gal to obtain units of lbs. pollutant/1000 gallons of gasoline.

iii. Diesel Powered Motor Vehicles

As discussed earlier (Section IV.C.2.a.), on-highway diesel consumption was derived by utilizing Bureau of Mines data[12] to apportion the state consumption of distillate fuel oil in 1970 by use category. On-highway diesel consumption using this technique agreed well with state totals obtained directly from the Highway Department[10] (within 7.5 percent). The value obtained from the state was felt to be more reliable and was utilized in this study.

On-highway diesel fuel was apportioned to the counties and the two cities under investigation by vehicle miles obtained from the South Dakota Highway Department.[10]

Emissions were calculated based upon the emission factors for heavy duty trucks and buses with engines built prior to 1970 as presented in McGraw and Duprey's Compilation of Air Pollutant Emission Factors - 1971.[18]

iv. Off-Highway Diesel Fuel (Farm Tractors)

As discussed earlier (Section IV.C.2.a.) off-highway diesel consumption was derived by utilizing Bureau of Mines statistics[12] to apportion the state consumption of distillate fuel oil in 1970 by use category. The resulting off-highway diesel value was assumed to be essentially all utilized by farm tractors and was therefore apportioned to the

counties by crop-acres.[8] Emission factors similar to those used for on-highway diesel fuel were utilized here.

v. Aircraft (Commercial Only)

Emissions from aircraft at the nine municipal airports were based on the number of landing and takeoff cycles (LTO) and aircraft type employed at each location, as described by McGraw and Duprey.[18] Airline schedules (effective dates April 25, 1971)[19] for the four commercial airlines operating in South Dakota (North Central, Western, Ozark, and Frontier) were utilized to determine the number of annual LTO's per airport and the type of aircraft employed. Table A in the appendix shows the number of annual engine-LTO's by aircraft type for each commercial airport in South Dakota.

vi. Railroads

The quantity of fuel oil utilized by railroads in South Dakota was obtained from Bureau of Mines data[12] and adjusted to reflect the difference between total annual state fuel oil sales as reported by the Bureau of Mines[12] and by state statistics.[7] This value was then apportioned to counties by track-miles as determined from a recently published detailed map of the state.

Fuel oil consumption by railroads in the cities of Sioux Falls and Rapid City was obtained directly from the railroads.[20] We are concerned primarily with fuel oil consumption utilized for switching operations as this is the major source of emissions from railroads within the city limits.[20]

Emissions were calculated based on the emission factors for railroads as presented in McGraw and Duprey's Compilation of Air Pollutant Emission Factors - 1971.[18]

vii. Evaporative Losses from Gasoline Marketing

Total gasoline sold both for highway and off-highway use in 1970 was available from the state Revenue Office. The quantity of highway gasoline marketing was apportioned to the counties and cities

under study by total vehicle miles as obtained from the Highway Department. Off-highway gasoline marketed was apportioned to the counties by crop-acres. The emissions were calculated based upon 21 pounds of hydrocarbons for each 1000 gallons of gasoline sold.[18]

c. Solid Waste Disposal

The state of South Dakota recently compiled information on the quantity of refuse collected and the handling and treatment procedures for each municipal dump and sanitary landfill in the state. Those dumps which practiced open burning were included as point sources. In assuming that 7 lbs./person per day of municipal refuse[25] which includes household, commercial and institutional refuse) is generated, the total refuse which remains uncollected can be estimated for each county by simply subtracting the refuse collected from the quantity generated. Two-thirds of the quantity uncollected was assumed to be open-burned, and one-third incinerated in commercial and/or institutional incinerators. For the two cities under investigation, all uncollected refuse was assumed to be incinerated.

Emissions were calculated based on the emission factors presented in McGraw and Duprey's Compilation of Air Pollutant Emission Factors - 1971.[18] Factors for industrial/commercial multiple chamber incineration were utilized for incineration area sources as recommended by OAP.

Based on a recently completed study of air pollution from municipal incineration,[26] as well as on communications with state officials, there are no municipal incinerators in South Dakota.

d. Process Losses

i. Grain Elevators

As mentioned earlier, 238 grain elevators did not return questionnaires. These non-respondents were therefore treated as area sources in their respective counties. Average emissions for both the country and terminal elevators were determined from those questionnaires

which were returned. The elevator type was then assigned to the non-responding elevators on the basis of elevator size (as determined by storage capacity).

ii. Dry Cleaning

McGraw and Duprey[18] have estimated that hydrocarbon emissions from dry cleaning operations in cold climates such as that of South Dakota average 2.7 pounds per person per day. This value was used for the determination of emissions from this source for the counties and two major urban areas of South Dakota.

iii. Surface Coating Operations

This category includes chiefly the application of paints and varnishes for protective and/or decorative purposes. No state surface coating consumption data were available for South Dakota, but a National total for paint and varnish was obtained from the U.S. Paint and Varnish Association.[21] From this total and the National population, it was determined that per capita consumption of paint and varnish is 0.0243 tons/person per year. This value was used with South Dakota population data[17] to determine the paint and varnish used in the pertinent geographical areas in the state. Information from the Paint and Varnish Association[21] indicated that the solvent content of these coatings averaged about 62.5 percent. In determining the hydrocarbon emissions from solvent evaporation, it was assumed that all of the solvent was hydrocarbon and that it all evaporated.

V. COMPUTER PRINTOUT

The detailed results of the emissions inventory are given in the computer printout which is forwarded in a separate binder.

The printout is arranged by Air Quality Region, and for each Region, there is a point source printout and an area source printout. The point source printout presents detailed data and also summaries of annual emissions by source category for each Political Jurisdiction (county) within the Region; these summaries are tabbed, "#8". Similarly, the area source printout presents detailed data and also summaries of annual emissions by source category for each Political Jurisdiction (county) within the Region; these summaries are tabbed, "#18".

Detailed notes on the data provided in the printout are now presented. They are arranged to follow the sequence of the printout sheets and should be read in conjunction with general explanations given in the Methodology section of this report. Numbered tabs are attached to the printout pages to indicate the first page of each listing.

A. POINT SOURCE PRINTOUT

Listing #1

The table presented correlates the emission factor set numbers shown in Listing #3 to the emission factors used in the computer-calculated emissions.

Listing #2

Standard Industrial Classifications and Process Codes were assigned to each source as shown in Table 12. Where more than one source had the same classification and Process Code, consecutive Site numbers were assigned to such sources.

The counties corresponding to the Political Jurisdiction numbers listed are shown in Table 13.

Each source was classified by Type as either Process, Boiler or Solid Waste. All fuel combustion sources were classified as

TABLE 12

STANDARD INDUSTRIAL CLASSIFICATION (SIC) NUMBERS AND ASSOCIATED PROCESS CODES

The source type identification code scheme used in this table is composed of the following sets of numbers:

A four-digit Standard Industrial Classification (SIC) code, XXXX, which identifies the nature of the industry.

A two-digit process code, XX, which provides the process classification.

A zero in the second location of the process code (X0) indicates a fuel combustion source. In this case, the first digit (X) identifies the fuel burner type (as defined below).

The fuel burner types defined by the process codes 00, 10, 20,...90 are defined as follows:

00. All types not listed
10. Pulverized, General
20. Pulverized, Dry Bottom
30. Wet Bottom without Flyash Reinjection - Pulverized
40. Pulverized, Wet Bottom with Flyash Reinjection
50. Cyclone
60. Spreader Stoker without Flyash Reinjection
70. Spreader Stoker with Flyash Reinjection
80. All other Stokers
90. Hand Fired

****

SOURCE TYPES FOUND IN SOUTH DAKOTA

2011 MEAT PACKING PLANTS

X0. Combustion
01. General

2029 DAIRY PRODUCTS

X0. Combustion
01. General

TABLE 12 (continued)

SOURCE TYPES FOUND IN SOUTH DAKOTA

2041 FLOUR AND OTHER GRAIN MILL PRODUCTS

- X0. Combustion
- 01. General
- 02. Wheat
- 03. Barley

2042 PREPARED FEEDS FOR ANIMALS AND FOWL

- X0. Combustion
- 01. General
- 02. Alfalfa

2833 MEDICINAL CHEMICALS AND BOTANICAL PRODUCTS

- X0. Combustion
- 01. General

2951 ASPHALT BATCHING

- X0. Combustion
- 01. Batching
- 02. Quarrying
- 03. Rock Drying
- 04. Sheet Rock Cutting and Trimming

2999 PRODUCTS OF PETROLEUM AND COAL, NOT ELSEWHERE CLASSIFIED

- X0. Combustion
- 01. General

3241 CEMENT, MANUFACTURING

- X0. Combustion
- 01. Dry Process
- 02. Wet Process
- 03. Sand Dryer

3251 BRICK AND STRUCTURAL CLAY

- X0. Combustion
- 01. General

Table 12 (continued)

3273 READY-MIXED CONCRETE

- X0. Combustion
- 01. General

3274 LIME PRODUCTION

- X0. Combustion
- 01. Rotary Kiln
- 02. Vertical Kiln

3295 MINERALS AND EARTH, GROUND OR OTHERWISE TREATED

- X0. Combustion
- 01. Crushing
- 02. Conveying, Screening, and Shaking
- 03. Storage Piles

4911 ELECTRIC COMPANIES AND SYSTEMS

- X0. Combustion

4953 REFUSE SYSTEMS

- X0. Combustion (fuel)
- 01. Municipal Incinerator
- 02. Open Burning
- 03. On-Site Multichamber Incinerator
- 04. On-Site Single Chamber Incinerator
- 05. Flue-fed Incinerator
- 06. Other

8061 HOSPITALS

- X0. Combustion

8221 COLLEGES, UNIVERSITIES, AND PROFESSIONAL SCHOOLS

- X0. Combustion

9100 FEDERAL GOVERNMENT

- X0. Combustion

TABLE 13

JURISDICTIONS INCLUDED WITHIN AIR QUALITY CONTROL REGIONS IN SOUTH DAKOTA

Black Hills-Rapid City Intrastate Air Quality Control Region - 205

In the State of South Dakota:

1. Butte County
2. Custer County
3. Fall River County
4. Lawrence County
5. Meade County
6. Pennington County

Metropolitan Sioux City Interstate Air Quality Control Region - 086

In the State of Iowa:

1. Plymouth County 2. Sioux County 3. Woodbury County

In the State of Nebraska:

4. Dakota County

In the State of South Dakota:

5. Union County

Metropolitan Sioux Falls Interstate Air Quality Control Region - 087

In the State of Iowa:

1. Lyon County

In the State of South Dakota:

2. Lincoln County
3. McCook County
4. Minnehaha County
5. Turner County

South Dakota Intrastate Air Quality Control Region (remaining area) - 206

In the State of South Dakota

1. Aurora County
2. Beadle County
3. Bennett County
4. Bon Homme County
5. Brookings County
6. Brown County
7. Brule County
8. Buffalo County
9. Campbell County
10. Charles Mix County
11. Clark County
12. Clay County
13. Codington County
14. Corson County
15. Davison County
16. Day County
17. Deuel County
18. Dewey County
19. Douglas County
20. Edmunds County

TABLE 13 (continued)

South Dakota Intrastate Air Quality Control Region (remaining area) - 206

21. Faulk County
22. Grant County
23. Gregory County
24. Haakon County
25. Hamlin County
26 Hand County
27. Hanson County
28. Harding County
29. Hughes County
30 Hutchinson County
31. Hyde County
32. Jackson County
33. Jerauld County
34. Jones County
35. Kingsbury County
36. Lake County
37. Lyman County
38. McPherson County
39. Marshall County
40. Mellette County
41. Miner County
42. Moody County
43. Perkins County
44. Potter County
45. Roberts County
46. Sanborn County
47. Shannon County
48. Spink County
49. Stanley County
50. Sully County
51. Todd County
52. Tripp County
53. Walworth County
54. Washabaugh County
55. Yankton County
56. Zieback County

Boiler although these included a small number of process combustion sources such as kilns.

Listing #3

The Shifts/Day figure is based on the ratio of the reported total operating hours to 8760 (total hours in a year).

The Use Factor figure is based on the ratio of maximum capacity to actual average operating rate. In the case of fuel combustion sources, average operating rate is the ratio of reported annual fuel consumption to reported hours operated.

The maximum and minimum Process Weight Rates are expressed in pounds per hour.

Listing #4

This listing is self-explanatory and no further comments will be included here.

Listing #5

This listing gives the totals of fuels consumed during the year within the Region. Note, for Region No. 206, two values are presented for each fuel. Regional totals are obtained by summing both values.

Listing #6

Computer calculated emissions were made for fuel combustion sources only, using the fuel totals and emission factor set numbers indicated. Solid Waste and Process sources were hand calculated. These hand calculations were based on annual solid waste and process totals together with emission factors from McGraw and Duprey (Table 10, No. 18).

The Uncontrolled figure is the sum of the computer calculated and hand calculated figures.

The Controlled figure is the uncontrolled figure minus the product of the Control Efficiency and the uncontrolled figure.

The Device Identification number corresponds to the control device listed in Table 14 of this report.

TABLE 14

POLLUTION REDUCTION DEVICES OR METHODS

001	Wet Scrubber - High Efficienty
002	Wet Scrubber - Medium Efficiency
003	Wet Scrubber - Low Efficiency
004	Gravity Collector - High Efficiency
005	Gravity Collector - Medium Efficiency
006	Gravity Collector - Low Efficiency
007	Centrifugal Collector - High Efficiency
008	Centrifugal Collector - Medium Efficiency
009	Centrifugal Collector - Low Efficiency
010	Electrostatic Precipitator - High Efficiency
011	Electrostatic Precipitator - Medium Efficiency
012	Electrostatic Precipitator - Low Efficiency
013	Gas Scrubber
014	Mist Eliminator - High Velocity
015	Mist Eliminator - Low Velocity
016	Fabric Filter - High Temperature
017	Fabric Filter - Medium Temperature
018	Fabric Filter - Low Temperature
019	Catalytic Afterburner
020	Catalytic Afterburner with Heat Exchanger
021	Direct Flame Afterburner
022	Direct Flame Afterburner with Heat Exchanger
027	Eliminate Coal Combustion
028	Eliminate Coal and Residual Fuel Oil Combustion
029	Change all Fuel Use to Natural Gas
030	No Fuel Use Over a Maximum Sulfur Content (Specified by the User in the Regional Data Base)
031	Same as Device 030 but with a Different Allowable Sulfur Content
039	Catalytic Oxidation - Flue Gas Desulfurization
041	Dry Limestone Injection
042	Wet Limestone Injection
043	Sulfuric Acid Plant - Contact Process
044	Sulfuric Acid Plant - Double Contact Process
045	Sulfur Plant

The Allowable figures are Particulate and SO_2 emissions based on the model federal regulations as published in the Federal Register, Volume 36, Number 67, on Wednesday, April 7, 1971. Allowable SO_2 emissions were calculated for combustion sources by assuming 80 percent removal.

Listing #7

The same notes apply as for Listing #6, except that no control devices or allowable emissions are considered.

Listing #8

This listing gives total emissions for each Political Jurisdiction (county) within the Region. The totals are presented by source category and fuel totals are included for combustion sources. Refuse totals are presented for each of the solid waste categories. The solid waste category marked, "other" is comprised of conical burners which consume wood scrap from lumber and saw mills.

Listing #9

This listing is reserved for comments helpful in clarifying the location of each of the point sources. The zone numbers specify whether the point source is located in Zone 13 or Zone 14 of the Universal Transverse Mercator (UTM) Coordinate System. This listing also allows for the presentation of allowable particulate and SO_2 emissions based on federal regulations. However, since these were presented in Listing #6, they were not included here.

B. AREA SOURCE PRINTOUT

Listings #10, #11, #12, #13, #14

Each listing presents emissions of one pollutant by Political Jurisdiction and consists of four printout tables. Emissions entitled, "Apportioned Emissions" (Table 1), and "Calculated Emissions", (Table 2) were computer calculated and based on emission factors presented below in Table 15 of this report. Note that in Table 2 of the printout, the two columns marked "other" refers to (from left to right):

TABLE 15

AREA SOURCE EMISSION FACTORS

NO.	AREA SOURCE CATEGORY	FUEL UNITS	EMISSION FACTORS (lbs./unit of fuel) PARTICULATE*	SO_2**	CO	HYDROCARBONS	NO_x
1	Residential Coal	Tons/year	2(A)	38(S)	50	12	5
2	Residential Oil	10^3 gallons/year	10	144(S)	5	3	12
3	Residential Natural Gas	10^6 cu.ft./year	19	0.6	20	8	75
4	Commercial & Institutional Coal	Tons/year	5(A)	38(S)	50	12	5
5	Commercial & Institutional Residual Oil	10^3 gallons/year	23	159(S)	0.2	3	60
6	Commercial & Institutional Distillate Oil	10^3 gallons/year	15	144(S)	0.2	3	60
7	Commercial & Institutional Natural Gas	10^6 cu.ft./year	19	0.6	20	8	75
8	Industrial Coal	Tons/year	13(A)	38(S)	2	1	15
9	Industrial Residual Oil	10^3 gallons/year	23	159(S)	0.2	3	60
10	Industrial Distillate Oil	10^3 gallons/year	15	144(S)	0.2	3	60
11	Industrial Natural Gas	10^6 cu.ft./year	18	0.6	0.4	40	175
12	Wood	Tons of wood/year	27	1.5	2	2	10
13	Open Burning	Tons of refuse/yr.	16	1	85	30	6
14	Incineration	Tons of refuse/yr.	7	1.5	10	3	3
15	Solvent Evaporation of Paints and Varnishes	Tons of solvent/yr	0	0	0	2000	0
16	Diesel Vessels	10^3 gallons/year	25	144(S)	65	50	73
17	Railroads	10^3 gallons/year	25	65	70	50	75
18	Diesel Motor Vehicles	10^3 gallons/year	25	45	325	65	340
19	Diesel Tractors	10^3 gallons/year	25	45	325	65	340
20	Urban Gasoline Motor Vehicles	10^3 vehicle miles per year	0.66	0.4	264	35.2	18.7
21	Rural Gasoline Motor Vehicles	10^3 vehicle miles per year	0.66	0.4	154	23.1	22
22	Gasoline Tractors	10^3 gallons/year	8.25	5.0	3300	440	233.75

* Particulate emissions from coal combustion obtained by multiplying appropriate factor by percent of ash in coal.

** SO_2 emissions from coal, distillate oil and residual oil combustion obtained by multiplying appropriate factor by percent sulfur in fuel. For distillate oil, the percent sulfur was assumed to equal 0.75%.

. Farm tractors utilizing diesel fuel

. Farm tractors utilizing gasoline

Table 3 of the printout, entitled, "Additional Emissions" was hand calculated. The basis for these hand calculations has been discussed in the Methodology Section (IV) of this report. Note that the explanation to the row numbers in Table 3 of the printout are presented below in Table 16 of this report.

Table 4 of the printout sums up the emissions from the preceding 3 tables. "Calculated 1" refers to Table 1; "Calculated 2" refers to Table 2; and "additional" refers to Table 3.

All emissions in these four tables are expressed in Tons per Year.

Listing #15

Printout Table 5 shows emission and fuel consumption totals for the Region. The source categories and appropriate units for the fuel totals corresponding to rows 1 through 22 are presented above in Table 15. All emissions are expressed in Tons per Year.

Listing #16

Tables 6-1 and 6-2 of the printout show the factors utilized to apportion each of the 22 fuel totals (see Listing #15) to the Political Jurisdictions in the Region. Note that the column headings 1-11 in Table 6-1 correspond to numbers 1-11 in Table 15 of this report and that column headings 1-11 in Table 6-2 correspond to numbers 12-22 also of Table 15. Table 17 of this report indicates the units of these apportioning factors.

Listing #17

Tables 6-3 and 6-4 present the apportioned fuel totals in each Political Jurisdiction for each of the 22 source categories presented in Listing #15. Again, column headings 1-11 in Table 6-3 correspond to numbers 1-11 of Table 15 above. Column headings 1-11 in Table 6-4 correspond to numbers 12-22 of Table 15.

Listing #18

This listing presents total area source emissions for each Political Jursidiction within the Region. The totals are presented by

TABLE 16

ADDITIONAL EMISSIONS

No.	Category		Units	Emission Factors (lbs./unit) Particulate	SO_2	CO	Hydrocarbons	NO_x
1	Gasoline Marketing-autos		10^3gal/yr.	0	0	0	21	0
2	Gasoline Marketing-Tractors		10^3gal/yr.	0	0	0	21	0
3	Dry Cleaning		Population	0	0	0	2.7	0
4	Liquid Petroleum Gas (LPG)		10^3gal/yr.	6.1	0.048	6.4	2.5	23
5	Aircraft	Turbofan-med.range	engine-LTO/yr*	7	2	16	50	7
		Turboprop	engine-LTO/yr*	6	1	2	3	5
6	Grain Elevators	Country	Grain elevators	68,000	0	0	0	0
		Terminal	Grain elevators	146,000	0	0	0	0
7-15	Not applicable		--	--	--	--	--	--

*engine-LTO cycle = engine landing-take-off cycle.

TABLE 17

UNITS FOR FACTORS (IN LISTING #16 OF PRINTOUT) UTILIZED TO APPORTION AREA SOURCE EMISSIONS BY COUNTY

Column Heading	Units of Apportioning Factors
1	--
2	No. of people
3	10^6 cu ft/yr of natural gas
4	--
5	--
6	No. of Wholesale and Retail Establishments
7	10^6 cu ft/yr of natural gas
8	--
9	--
10	No. of Manufacturing Employees
11	10^6 cu ft/yr of natural gas
12	--
13	Tons per year of refuse burned
14	Tons per year of refuse incinerated
15	No. of Manufacturing Employees
16	--
17	Track Miles x 10'
18	Daily Diesel vehicle miles
19	1000's of crop acres
20	Annual Urban Vehicle Miles x 10^{-4}
21	Annual Rural Vehicle Miles x 10^{-4}
22	1000's of crop acres

source category. As mentioned earlier, the two "others" in column 1 refer to (from top to bottom).

- Farm tractors utilizing diesel fuel
- Farm tractors utilizing gasoline

The explanation of "additional Pollutant" numbers 1-15 are found above in Table 16 of this report.

The fuel total units are the same as those presented above in Table 15 of this report.

All emissions are expressed in Tons per Year.

APPENDIX

TABLE A

COMMERCIAL AIRCRAFT LANDING-TAKE-OFF CYCLES IN SOUTH DAKOTA (1970)

Airport	County	Aircraft Class	No. of Engine-LTO cycles/yr.
Rapid City	Pennington	Turbofan-Medium Range	9,490
		Turboprop	2,190
Sioux Falls	Minnehaha	Turbofan-Medium Range	13,870
		Turboprop	12,410
Watertown	Codington	Turbofan-Medium Range	1,460
		Turboprop	5,110
Pierre	Hughes	Turbofan-Medium Range	4,380
		Turboprop	1,460
Aberdeen	Brown	Turbofan-Medium Range	1,460
		Turboprop	4,380
Huron	Beadle	Turboprop	2,920
Yankton	Yankton	Turboprop	2,920
Brookings	Brookings	Turboprop	2,920
Mitchell	Davison	Turboprop	3,650

South Dakota Air Pollution Commission
State Department of Health
Pierre, South Dakota 57501

AIR CONTAMINANT EMISSIONS SURVEY

INFORMATION IS TO BE REPRESENTATIVE OF CALENDAR YEAR

FOR OFFICE USE ONLY
Rec'd by: _____
Reviewed by: _____
County: _____
Coordinates: _____
SIC No. _____

Firm Name: _____

Person to contact regarding this report _____ Title _____ Phone _____

Mailing address _____

Plant address _____

Nature of business: (Products) _____

Employees at plant location _____ If seasonal, give range _____ Approximate land area at plant location _____

SECTION I - FUEL USE FOR GENERATION OF HEAT, STEAM AND POWER

Normal operating schedule _____ Hours per day _____ Days per week _____ Weeks per year _____

Seasonal and/or peak operation period: _____

Estimate of percent of total fuel consumed to provide space heat _____

	A	B	C	D	E	F	G	H	I	J	K	L
				Fuel data (D)					Air cleaning equip.		Est. of contaminants (M)	
Source No. (A)	Size of unit (input) 10^6 BTU/hr (B)	Type Unit (C)	Installation Date	Type Fuel (E)	Amount (F) per year	Heat content BTU (G)	Percent sulfur (G-H)	% ash (G-H coal only	Type (I)	Efficiency % (J)	Type (K)	Quantity (L)

SECTION II - REFUSE DISPOSAL

Refuse disposed of _____ On site _____ Off site - Location of disposal and/or name of hauler: _____

Normal on-site combustion operating schedule: _____ Hours per day _____ Days per week _____ Weeks per year _____

Seasonal and or peak operation period: (Specify) _____

	A	B	C	D	E	F	G	H
	Waste Material						Estimate of contaminants (M)	
Source No. (A)	Type (N)	Amount per year (F)	Method of disposal (See Code Page 3)	Incinerate capacity, lb./hr.	Auxiliary fuel used (o)	Type and efficiency air cleaning equipment (I-J)	Type (K)	Quantity (L) per year

Use additional sheets if necessary

AIR CONTAMINANT EMISSIONS SURVEY

SECTION III - PROCESS EMISSIONS

Normal operating schedule: _____ Hours per day _____ Days per week _____ Weeks per year _____

Seasonal and/or peak operation period: _____

Note: For intermittent operations, indicate approximate frequency and duration so that estimates of yearly emissions may be obtained.

	A	B	C	D	E	F	G	H	I
Source No. (A)	Processes or operations releasing contaminants to atmosphere (A-P)	Installation Date	Materials processed and/or used at operations		Quantity of gas discharged from process or operation	Type & efficiency air cleaning equipment (I-J)	Estimate of contaminants (M)		Basis of estimate (R)
			Type (Q)	Quantity per year (F)			Type (K)	Quantity per year (L)	(Please specify basis)

SECTION IV - STACK DATA

SOURCES VENTED (5)	Height (Feet)	Inside Diameter (Feet)	EXIT GAS		
			Temperature °F	Velocity (FPS)	Moisture (%)

Any Supplemental material or data considered pertinent (flow diagrams, reports, summaries, test results, maps) should be submitted with this form.

Name and title of official submitting reports _____

Use additional sheets if necessary

CODE:

A. Give a different no. to represent each source and then give stack data opposite the same number on Section IV.
B. Nameplate data are sufficient.
C. Hand-fired; underfeed, traveling-grate or spreader stoker; cyclone furnace; pulverized, wet or dry bottom with or without fly ash reinjection; rotary or gun-type oil burner; etc.
D. Fuel data are to be reported on "as burned basis."
E. Coke, bituminous coal, anthracite coal; No. 1, 2, 4, 5 or 6 fuel oil; natural gas; LPG; refinery or coke oven gas; wood, etc.
F. Pounds, tons, or gallons per year.
G. If unknown please give name and address of fuel supplier.
H. Sulfur and ash content for each fuel should be a weighted average.
I. Cyclone, scrubber, electrostatic precipitator, baghouse, settling chamber, etc.
J. Please state if efficiency is a rated or operating efficiency.
K. Fly ash, sulfur oxides, etc. (include chemical description).
L. Pounds or tons per year.
M. Give stack test data if available, or otherwise specify basis used.
N. Rubbish, garbage, mixed garbage and rubbish, waste paper, wood chips or sawdust, etc.
O. Indicate whether auxiliary fuel is used in incinerators and pit burning, and the amount.
P. Sulfuric acid-chamber, alumimum smelting-crucible furnace, iron melting-cupola, cement manufacture-dry process, solvent cleaning or other (please specify).
Q. Acid produced, tons; metal charged or processed, tons; cement produced, bbl.; solvent consumed, gallons; etc. per year.
R. Process material balance studies, field tests by plant or by equipment manufacturers, or other basis.
S. List sources Sections I, II, III which utilize each stack.

METHOD OF DISPOSAL CODE:

1. Open-burning dump
2. Sanitary landfill. (no burning)
3. Burned in boiler or furnace.
4. Incinerator, single chamber.
5. Incinerator, multiple chamber.
6. Incinerator, rotary.
7. Conical metal burner.
8. Other (Specify)

QUESTIONNAIRE FOR GRAIN HANDLING OPERATION — OFFICE USE ONLY

DATE FOR YEAR _____

Rec'd by: _____
Reviewed by: _____
County: _____
Coordinates: _____

Return to:
SOUTH DAKOTA AIR POLLUTION CONTROL COMMISSION
STATE DEPARTMENT OF HEALTH
PIERRE, SOUTH DAKOTA 57501

General

A. Company Name _____

Plant Address _____

City _____ Zip Code _____

B. Person to Contact

Name _____

Position _____

Telephone No. _____

C. Average Number of Employees _____

D. Operating Schedule

_____ Hrs/Day (if seasonal, give range)

_____ Days/Year

II. Process Information

		Tons/Year
A.	Terminal Elevators	
1.	Shipping or Receiving	_____
2.	Transferring, Conveying, etc.	_____
3.	Screening and Cleaning	_____
4.	Drying	_____
B.	Country Elevators	Tons/Year
1.	Shipping or Receiving	_____
2.	Transferrring, Conveying, etc.	_____
3.	Screening and Cleaning	_____
C.	Grain Processing	Tons/Year
1.	Alfalfa Dehydrating	_____
2.	Alfalfa Meal Milling	_____
3.	Corn Meal	_____
4.	Soybean Processing	_____
5.	Malted Barley or Wheat Cleaner	_____
6.	*Milo Cleaner or Rice Dryer	_____
7.	*Barley Flour or Rice Milling	_____
8.	Wheat Milling	_____
D.	*Feed Manufacturing	_____

E. Control Equipment

1. Type of Dust Collector(s) (Specify separately for each process with emissions) _____
2. Design Efficiency _____
3. Quantity Retained in collector(s), Tons/Year _____

*Specify which

SAWMILL EMISSION QUESTIONNAIRE
DATA FOR YEAR _____

OFFICIAL USE ONLY
Rec'd by: _____
Reviewed by: _____
County: _____
Coordinates: _____
SIC No. _____

Return to:
South Dakota Air Pollution Control Commission
State Department of Health
Pierre, South Dakota 57501

I. General

A. Name of Company _____

Plant Address _____

City _____ State _____ Zip _____

B. Person to Contact _____ Position _____

Telephone No. _____

C. Operating Schedule _____ Hrs/Day _____ Days/Year

II. Process Information

A. Dust Producing Operations

1. Amount/Year (Tons) processed in each step:

Debarking _____

Cutting _____

Planing _____

Other _____

2. Is a burner used at this site? Yes / / No / /

If yes, give amount burned/year (Tons) _____, and:

a. Date of Installation _____

b. Burner Data: Base Dia. (ft.) _____ Top Dia. (ft.) _____

Height (ft.) _____ Top Screen Size _____ Capacity _____

c. Firing Data: % Excess Air _____ Exit Gas Temp °F _____

Type Overfire - tangential or radial

Method of Charge - Bulldozer, conveyor, or other

d. Control Equipment: Type _____

Per Cent Efficiency _____ % Date of Installation _____

CONCRETE BATCH PLANTS
DATA FOR YEAR _____

OFFICE USE ONLY
Rec'd:_____
Reviewed by :_____
County:_____
Coordinates:_____
SIC No._____

RETURN TO:
South Dakota Air Pollution Control Commission
State Department of Health
Pierre, South Dakota 57501

I. General

A. Company Name _____

Plant Address_____

City_____State_____Zip_____

B. Person to Contact

Name_____

Position_____

Telephone No._____

C. Average Number of Employees_____

D. Operating Schedule

_____Hrs/Day (if seasonal, give range)

_____Days/Year

II. Process Information

A. Amount Produced During Year_____(tons) or _____(cubic yards)

B. Control Equipment

Type _____

Efficency _____%

Installation Date_____

ASPHALT BATCH PLANTS

DATA FOR YEAR _____

OFFICE USE ONLY

Rec'd. by: _____
Reviewed by: _____
County: _____
Coordinates _____
SIC No.: _____

Return to:
SOUTH DAKOTA AIR POLLUTION CONTROL COMMISSION
STATE DEPARTMENT OF HEALTH
PIERRE, SOUTH DAKOTA 57501

I. General

A. Company Name _____

Plant Address _____

City _____ Zip Code _____

B. Person to Contact

Name _____

Position _____ Telephone No. _____

C. Average Number of Employees _____

_____Hrs/Day (if seasonal, give range)

_____Days/Year

II. Process Information

A. Amount of Asphalt Produced During Year _____ (Tons)

B. Control Equipment on Dryer

Equipment Type	% Efficiency	Installation Date
Precleaner		
Cyclone		
Scrubber		
Centrifugal		
Orifice Type		
Baffle Spray Tower		
Bag House		
Other		

C. Fuel Use

Type _____ Amount _____

FERTILIZER QUESTIONNAIRE
DATA FOR YEAR _____

OFFICIAL USE ONLY
Rec'd. by:_____
Reviewed by:_____
County:_____
Coordinates:_____
SIC No._____

Return to:
South Dakota Air Pollution Control Commission
State Department of Health
Pierre, South Dakota 57501

I. General Information

A. Name of Firm_____

Plant Address_____City_____State_____

Mailing Address_____City_____State_____

B. Person to contact concerning this form_____

Telephone_____Position_____

C. Operating schedule_____Hrs/day (if seasonal, give range_____

Days/yr.

II. Process Information

A. Nitrate Fertilizer

1. Amount of Fertilizer Produced_____tons/yr.

2. Type Equipment (Please check)

a. Granulator_____or Drilling Tower_____

b. Neutralizer_____

c. Dryers and coolers_____

B. Phosphate Fertilizer

1. Amount of Fertilizer Produced_____tons/yr.

2. Type of Product (Please check)

a. Normal Superphosphate_____

b. Triple Superphosphate_____

c. Diammonium Phosphate_____

3. Type of Operations (Please check)

a. Grinding_____

b. Drying_____

c. Cooling_____

d. Granulating_____

e. Packaging, shipping_____

D. Control Equipment

Operation	Type of Equipment	Percent Efficiency

E. Stack Data

Source	Height	Diameter	Exit Temperature	Exit Velocity

III. Additional Process Information (Not Described Above)

A. Flow Sheet of Process

B. Other information not mentioned above

MINING OR STONE QUARRYING PROCESSING QUESTIONNAIRE

DATA FOR YEAR _____

OFFICIAL USE ONLY

Rec'd by: _____

Reveiwed by: _____

County: _____

Coordinator: _____

SIC.: _____

Return to:

South Dakota Air Pollution Control
State Department of Health
Pierre, South Dakota 57501

I. General Information

A. Name of Firm _____

Plant Address _____ City _____ State _____

Mailing Address _____ City _____ State _____

B. Person to contact concerning this form _____

Telephone _____ Position _____

C. Operating Schedule _____ Hrs/day (If seasonal, give range) _____

_____ Days/yr

II. Process Information

A. Name of mineral mined _____

B. Raw Material processed _____ Tons/yr

C. Amount Produced _____ Tons/yr

D. Crushing Operations (Please Check)

1. Primary Crushing _____
2. Secondary Crushing & Screening _____
3. Tertiary Crushing & Screening _____
4. Fines Milling _____
5. Recrushing and Screening _____

a. Amount _____ Tons/yr

D. Miscellaneous Operations (Please Check)

1. Screening _____
2. Conveying _____
3. Handling _____
4. Storing-Piles _____

III. Additional Process Information (Not described above)

IV. Stack Data

Source	Height	Diameter	Exit velocity	Exit Temperature

V. Control Equipment

Operation	Type of Equipment	Percent Efficiency

CRUDE OIL DRILLING, NATURAL GAS
OR LPG FACILITIES QUESTIONNAIRE
DATA FOR YEAR _____

OFFICE USE ONLY
Rec'd by: _____
Reviewed by: _____
County: _____
Coordinates: _____
SIC. No. _____

Return to:
South Dakota Air Pollution Control Commission
State Department of Health
Pierre, South Dakota 57501

I. General Information

Company Name _____

Plant Address _____ City _____ State _____

Mailing Address _____ City _____ State _____

B. Person to contact about this form _____

Telephone _____ Position _____

C. Operating Schedule: other than continuous operation, Please specify

_____

II. Process Information

A. Drilling Operations: Type of well (natural gas or crude) _____

Quantity pumped (bbl, gal, cu. ft. per yr.) _____

Oil _____ Water _____

Casing-head gasoline _____ Sulfur content of crude _____

Amount Flared _____ H_2S Content _____

Sump Loss _____ (bbls, gal per yr.)

B. Crude Handling and Storage

Amount transferred to storage _____ (bbl, gal per yr.)

Type storage tanks (floating or fixed roof) _____

No. of Tanks _____ Height _____ (ft.) Diameter _____ (ft.)

Sump Loss _____ (bbl/yr)

C. Natural GAs Operations and LPG Plants

Cu. ft. processed/yr. (compressed, absorbed, etc.) specify processes

_____

Fuel Burned/yr.: In boilers _____ In gas engines _____

Boiler Capacity (BTU/Hr) _____ Stack Height (ft.) _____

Dia. (ft.) _____ Exit Vel. _____ (ft./sec.) Exit Temp. _____ °F

NOTE: Fill out separate questionnaires for each location.

PETROLEUM STORAGE
DATA FOR YEAR_____

OFFICE USE ONLY
REC'D BY:_____
REVIEWED BY:_____
COUNTY:_____
COORDINATES:_____
SIC. NO.:_____

Return to:
South Dakota Air Pollution Control Commission
State Department of Health
Pierre, South Dakota 57501

I. General Information

A. Company Name _____

Plant Address _____ City _____ State ____

Mailing Address_____ City _____ State ____

B. Person to contact about this form _____

Telephone _____ Position _____

C. Operating Schedule: other than continuous operation, Please specify

_____

II. Facility Information

A. Gasoline

1. No. of tanks _____
2. Tank capacities _____ gal.per tank (ave.)
3. Total Storage Capacity _____ gallons
4. Volume handled: _____ gal./yr.
5. Storage Temp.(If heating is utilized) _____ $^{o}F.$

B. Diesel Fuel

1. No. of tanks _____
2. Tank capacities _____ gal. per tank (ave.)
3. Total Storage Capacity _____ gallons
4. Volume handled: _____ gal./yr.
5. Storage Temp.(If heating is utilized) _____ $^{o}F.$

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C. #1 Fuel Oil

1. No. of tanks _____
2. Tank capacities _____ gal. per tank (ave.)
3. Total Storage Capacity _____ gallons
4. Volume handled: _____ gal./yr.
5. Storage Temp.(If heating is utilized)_____ ^{o}F.

D. #2 Fuel Oil

1. No. of tanks _____
2. Tank capacities _____ gal.per tank (ave.)
3. Total Storage Capacity _____ gallons
4. Volume handled: _____ gal./yr.
5. Storage Temp.(If heating is utilized) _____ ^{o} F.

E. #3 Fuel Oil

1. No. of tanks _____
2. Tank capacities _____ gal.per tank (ave.)
3. Total Storage Capacity _____ gallons
4. Volume handled: _____ gal./yr.
5. Storage Temp.(If heating is utilized) _____ ^{o}F.

F. #5 Fuel Oil

1. No. of tanks _____
2. Tank capacities _____ gal per tank (ave.)
3. Total Storage Capacity _____ gallons
4. Volume handled: _____ gal./yr
5. Storage Temp.(If heating is utilized) _____ ^{o}F.

G. #6 Fuel Oil

1. No. of tanks _____

2. Tank capacities _____ gal. per tank (ave.)

3. Total Storage Capacity _____ gallons

4. Volume handled: _____ gal./yr.

5. Storage Temp.(If heating is utilized) _____ $^{o}F.$

GYPSUM PROCESSING QUESTIONNAIRE
DATA FOR YEAR _____

OFFICIAL USE ONLY

Rec'd by: _____
Reviewed by: _____
County: _____
Coordinates: _____
SIC. No. _____

Return to:

South Dakota Air pollution Control Commission
State Department of Health
Pierre, South Dakota 57501

I. General Information

A. Name of Firm _____

Plant Address _____ City _____ State _____

Mailing Address _____ City _____ State _____

B. Person to contact concerning this form _____

Telephone _____ Position _____

C. Operating schedule _____ Hrs/day (If seasonal, give range) _____

_____ Days/yr

D. Fuel Information

Type Fuel	Amount Per Year	Heat Content BTU	% Sulfur	% Ash Coal Only

II. Process Information

A. Gypsum Processed _____ Tons/yr

B. Type of operations used in process (Please check)

1. Raw material drying _____
2. Primary grinding _____
3. Calcining _____
4. Conveying _____
5. End Sawing _____

6. Fiber Milling _____

7. Stucco mixing _____

8. Others(that may be sources of emissions) (Please specify) _____

III. Additional Process Information

A. Flow Sheet of Process

B. Other Information that may aid in evalating process

IV. Stack Data

Source	Height Ft.	Diameter Ft.	Exit Temp °F	Exit Velocity

V. Control Equipment

Operation Controlled	Type of equipment	% Efficiency